COURSE OUTLINE

MEC303 Computational Mechanics

School: School of Science, Technology and Engineering

2023 | Semester 2

UniSC Sunshine Coast
UniSC Moreton Bay

BLENDED LEARNING

Most of your course is on campus but you may be able to do some components of this course online.

Please go to usc.edu.au for up to date information on the teaching sessions and campuses where this course is usually offered.

1. What is this course about?

1.1. Description

Computer aided engineering (CAE) is now a common step in the design of engineering structures. This course builds on the knowledge and skills gained in Mechanics of Materials and Dynamics 1. You will gain an understanding of the operation and limitations of CAE systems. You will have the opportunity to develop the skills required to design such structures and systems. Material presented includes a brief discussion on the architecture of CAE systems, numerical methods and finite element methods. Considerable emphasis is placed on the appropriate use of the finite element method in the design process.

1.2. How will this course be delivered?

ACTIVITY	HOURS	BEGINNING WEEK	FREQUENCY
BLENDED LEARNING			
Learning materials – Asynchronous Learning Material: Students are required to watch a pre-recorded learning material in Canvas	1hr	Week 1	13 times
Tutorial/Workshop 1 – On Campus Tutorials: Students are asked to solve the tutorial questions based on the theories and methods in the learning materials	2hrs	Week 1	13 times
Laboratory 1 – On Campus Lab: Students will practice the finite element analysis software in the PC labs	2hrs	Week 2	12 times

1.3. Course Topics

- Matrix algebra
- Finite element method
- Discretisation and other approximations
- Stiffness and displacement methods
- Bars beams, truss and linear statics analysis
- Plane stress and plane strain
- Frame and grids
- Thermal stress

2. What level is this course?

300 Level (Graduate)

Demonstrating coherence and breadth or depth of knowledge and skills. Independent application of knowledge and skills in unfamiliar contexts. Meeting professional requirements and AQF descriptors for the degree. May require pre-requisites where discipline specific introductory or developing knowledge or skills is necessary. Normally undertaken in the third or fourth full-time study year of an undergraduate program.

3. What is the unit value of this course?

12 units

4. How does this course contribute to my learning?

COURSE LEARNING OUTCOMES	GRADUATE QUALITIES MAPPING	PROFESSIONAL STANDARD MAPPING *
On successful completion of this course, you should be able to...	Completing these tasks successfully will contribute to you becoming...	Engineers Australia Stage 1 Professional Engineer Competency Standards
1 Explain the concepts and principles used in the formulation and application of the finite element method.	Knowledgeable Creative and critical thinker	1.1, 1.2
2 Formulate, implement, and document solutions to solve simple engineering problems using the finite element method.	Empowered Engaged	2.1, 2.2
3 Identify and use appropriate software packages to assist in the solution of a range of common engineering problems.	Creative and critical thinker Engaged	2.1, 2.2
4 Evaluate the performance of an existing design using computer aided engineering software to evaluate the validity of the model and solution in relation to the original problem specification .	Empowered Engaged	1.6, 2.3
5 Communicate concepts in computational mechanics in writing.	Knowledgeable	3.2, 3.4

* Competencies by Professional Body

CODE	COMPETENCY
ENGINEERS AUSTRALIA STAGE 1 PROFESSIONAL ENGINEER COMPETENCY STANDARDS	
1.1	Knowledge and Skill Base: Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
1.2	Knowledge and Skill Base: Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.
1.6	Knowledge and Skill Base: Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline.
2.1	Engineering Application Ability: Application of established engineering methods to complex engineering problem solving.
2.2	Engineering Application Ability: Fluent application of engineering techniques, tools and resources.
2.3	Engineering Application Ability: Application of systematic engineering synthesis and design processes.
3.2	Professional and Personal Attributes: Effective oral and written communication in professional and lay domains.
3.4	Professional and Personal Attributes: Professional use and management of information.

5. Am I eligible to enrol in this course?

Refer to the UniSC Glossary of terms for definitions of "pre-requisites, co-requisites and anti-requisites".

5.1. Pre-requisites

ENG227 or MEC227 or MCH200 and (ENG205 or MEC205 or MEC2401) and (ENG221 or MEC221) and enrolled in Program SC405 or SC411

5.2. Co-requisites

Not applicable

5.3. Anti-requisites

MEC3302 or ENG303

5.4. Specific assumed prior knowledge and skills (where applicable)

Not applicable

6. How am I going to be assessed?

6.1. Grading Scale

Standard Grading (GRD)

High Distinction (HD), Distinction (DN), Credit (CR), Pass (PS), Fail (FL).

6.2. Details of early feedback on progress

6.3. Assessment tasks

DELIVERY MODE	TASK NO.	ASSESSMENT PRODUCT	INDIVIDUAL OR GROUP	WEIGHTING %	WHAT IS THE DURATION / LENGTH?	WHEN SHOULD I SUBMIT?	WHERE SHOULD I SUBMIT IT?
All	1	Quiz/zes	Individual	30%	1000 words	Refer to Format	Online Test (Quiz)
All	2	Report	Individual	30%	1500 words	Week 10	Online Submission
All	3	Report	Individual	40%	2500 words	Exam Period	Online Submission

All - Assessment Task 1: Tutorial Exercises

GOAL:	The goal of this task is to demonstrate your understanding of discretisation and finite elements and use this knowledge to solve structural problems.
PRODUCT:	Quiz/zes
FORMAT:	Submit: Week 4, week 8, week 12 This task is to ensure that you understand the theoretical basis for discretisation and finite element methods. Prepare the written solutions to cover problems from concepts covered in Computational Mechanics.

CRITERIA:

No.		Learning Outcome assessed
1	Use of analytical and numerical methods for representing static structures	1 2
2	Development of matrices for solving structural stress analysis	2
3	Application of mathematical models	2
4	Construction of simple solid models using a modelling software	3 4

All - Assessment Task 2: FEA Problems with simple systems

GOAL:	The goal is to apply engineering theory to evaluate simple systems and propose and justify solutions to structural problems.
PRODUCT:	Report
FORMAT:	You will be given a set of problems representing a system of static structure. You will analyse the system using the finite element method and a CAE tool. This includes the accurate use of discretisation and an analysis of stress and strain. The analysis will assist you to formulate possible solutions for improvement to the structure

CRITERIA:

No.		Learning Outcome assessed
1	Use of analytical and numerical methods approach to static structures	1
2	Application of matrices for solving structural stress analysis	2
3	Construction and application of mathematical models	2
4	Construction of simple solid models using a modelling software	3 4
5	Formulation and justification of structural solutions	2
6	Written communication	5

All - Assessment Task 3: Mini Project

GOAL:	The goal is to evaluate the performance of an existing design using computer-aided engineering software to evaluate the validity of the model and solution in relation to the original problem specification
PRODUCT:	Report
FORMAT:	You will provide a written report detailing: Solid computer model application of stress and thermal stress design specification

CRITERIA:

No.		Learning Outcome assessed
1	Accuracy of computer model of the existing system	1 2
2	Application of discretisation	3 4
3	Assumptions and proposed solutions	4 5
4	Written analysis and communication in report format	5

7. Directed study hours

A 12-unit course will have total of 150 learning hours which will include directed study hours (including online if required), self-directed learning and completion of assessable tasks. Student workload is calculated at 12.5 learning hours per one unit.

7.1. Schedule

PERIOD AND TOPIC	ACTIVITIES
1	Revising mechanics of materials concepts
2	Review of Matrix notation
3	Finite element methods
4	Stiffness and displacement
5	Stiffness and displacement
6	Adapting problems for computer solution
7	Truss analysis using stiffness method
8	Beam analysis using stiffness method
9	Frame and Grid equations
10	Plane stress and plane strain stiffness equations
11	FEM of plane stress and plane strain
12	Thermal stress and FEM
13	Review

8. What resources do I need to undertake this course?

Please note: Course information, including specific information of recommended readings, learning activities, resources, weekly readings, etc. are available on the course Canvas site– Please log in as soon as possible.

8.1. Prescribed text(s) or course reader

Please note that you need to have regular access to the resource(s) listed below. Resources may be required or recommended.

REQUIRED?	AUTHOR	YEAR	TITLE	EDITION	PUBLISHER
Required	Daryl L. Logan	2016	A First Course in the Finite Element Method, SI Edition	6th Ed	Cengage Learning

8.2. Specific requirements

N/A

9. How are risks managed in this course?

Health and safety risks for this course have been assessed as low. It is your responsibility to review course material, search online, discuss with lecturers and peers and understand the health and safety risks associated with your specific course of study and to familiarise yourself with the University's general health and safety principles by reviewing the online induction training for students, and following the instructions of the University staff.

10. What administrative information is relevant to this course?

10.1. Assessment: Academic Integrity

Academic integrity is the ethical standard of university participation. It ensures that students graduate as a result of proving they are competent in their discipline. This is integral in maintaining the value of academic qualifications. Each industry has expectations and standards of the skills and knowledge within that discipline and these are reflected in assessment.

Academic integrity means that you do not engage in any activity that is considered to be academic fraud; including plagiarism, collusion or outsourcing any part of any assessment item to any other person. You are expected to be honest and ethical by completing all work yourself and indicating in your work which ideas and information were developed by you and which were taken from others. You cannot provide your assessment work to others. You are also expected to provide evidence of wide and critical reading, usually by using appropriate academic references.

In order to minimise incidents of academic fraud, this course may require that some of its assessment tasks, when submitted to Canvas, are electronically checked through Turnitin. This software allows for text comparisons to be made between your submitted assessment item and all other work to which Turnitin has access.

10.2. Assessment: Additional Requirements

Your eligibility for supplementary assessment in a course is dependent of the following conditions applying:

The final mark is in the percentage range 47% to 49.4%
The course is graded using the Standard Grading scale
You have not failed an assessment task in the course due to academic misconduct

10.3. Assessment: Submission penalties

Late submission of assessment tasks may be penalised at the following maximum rate:
- 5% (of the assessment task's identified value) per day for the first two days from the date identified as the due date for the assessment task.
- 10% (of the assessment task's identified value) for the third day - 20% (of the assessment task's identified value) for the fourth day and subsequent days up to and including seven days from the date identified as the due date for the assessment task.
- A result of zero is awarded for an assessment task submitted after seven days from the date identified as the due date for the assessment task. Weekdays and weekends are included in the calculation of days late. To request an extension you must contact your course coordinator to negotiate an outcome.

10.4. SafeUniSC

UniSC is committed to a culture of respect and providing a safe and supportive environment for all members of our community. For immediate assistance on campus contact SafeUniSC by phone: 07 5430 1168 or using the SafeZone app. For general enquires contact the SafeUniSC team by phone 07 5456 3864 or email safe@usc.edu.au.

The SafeUniSC Specialist Service is a Student Wellbeing service that provides free and confidential support to students who may have experienced or observed behaviour that could cause fear, offence or trauma. To contact the service call 07 5430 1226 or email studentwellbeing@usc.edu.au.

10.5. Study help

For help with course-specific advice, for example what information to include in your assessment, you should first contact your tutor, then your course coordinator, if needed.

If you require additional assistance, the Learning Advisers are trained professionals who are ready to help you develop a wide range of academic skills. Visit the Learning Advisers web page for more information, or contact Student Central for further assistance: +61 7 5430 2890 or studentcentral@usc.edu.au.

10.6. Wellbeing Services

Student Wellbeing provide free and confidential counselling on a wide range of personal, academic, social and psychological matters, to foster positive mental health and wellbeing for your academic success.

To book a confidential appointment go to Student Hub, email studentwellbeing@usc.edu.au or call 07 5430 1226.

10.7. AccessAbility Services

Ability Advisers ensure equal access to all aspects of university life. If your studies are affected by a disability, learning disorder mental health issue, injury or illness, or you are a primary carer for someone with a disability or who is considered frail and aged, AccessAbility Services can provide access to appropriate reasonable adjustments and practical advice about the support and facilities available to you throughout the University.

To book a confidential appointment go to Student Hub, email AccessAbility@usc.edu.au or call 07 5430 2890.

10.8. Links to relevant University policy and procedures

For more information on Academic Learning & Teaching categories including:

- Assessment: Courses and Coursework Programs
- Review of Assessment and Final Grades
- Supplementary Assessment
- Central Examinations
- Deferred Examinations
- Student Conduct
- Students with a Disability

For more information, visit https://www.usc.edu.au/explore/policies-and-procedures#academic-learning-and-teaching

10.9. Student Charter

UniSC is committed to excellence in teaching, research and engagement in an environment that is inclusive, inspiring, safe and respectful. The Student Charter sets out what students can expect from the University, and what in turn is expected of students, to achieve these outcomes.

10.10. General Enquiries

In person:

- **UniSC Sunshine Coast** - Student Central, Ground Floor, Building C, 90 Sippy Downs Drive, Sippy Downs
- **UniSC Moreton Bay** - Service Centre, Ground Floor, Foundation Building, Gympie Road, Petrie
- **UniSC SouthBank** - Student Central, Building A4 (SW1), 52 Merivale Street, South Brisbane
- **UniSC Gympie** - Student Central, 71 Cartwright Road, Gympie
- **UniSC Fraser Coast** - Student Central, Student Central, Building A, 161 Old Maryborough Rd, Hervey Bay
- **UniSC Caboolture** - Student Central, Level 1 Building J, Cnr Manley and Tallon Street, Caboolture

Tel: +61 7 5430 2890

Email: studentcentral@usc.edu.au